CHANGING TIMES CHANGING VALUES

Social/Cultural Values: Economic Valuation

Fish and Wildlife Valuation - Montana

Outline of Presentation: Fish and Wildlife Valuation

I. Introduction/valuation concepts

II. Nonmarket applications in Montana: research and policy

III. Consumptive use values: fishing and hunting in Montana

IV. Nonconsumptive and passive use: wolf recovery in YNP

I. INTRODUCTION

Basic questions addressed

1. What kinds of studies have been done in MT?
2. How are nonmarket values estimated?
3. Are results consistent with economic theory?
4. How do values vary across activity, species, site and user group?
5. What do we know about the trend in values?
6. What can we learn from national level meta-analysis?

Key Montana Fish and Wildlife Resources and Uses

- Stream and lake fishing in Columbia, Kootenai, Upper Missouri and Yellowstone River Basins
- Big game hunting statewide (esp. elk, deer and antelope)
- Wildlife viewing in Yellowstone NP

Preview of general findings

1. Nonmarket valuation has played a significant role in Montana natural resource policy
2. Valuation and policy conclusions sensitive to definition of spatial extent of the market (e.g. are these "Montana" or "national" resources).
3. Resources and users are heterogeneous; values vary significantly across activity, site, species, and user group
4. Trend in use values for MT fish and wildlife resources may vary across "market segments"

Fish and wildlife are primarily "nonmarket resources" in the U.S.

- historical evolution of property rights
- some uses are "pure public goods"
- to avoid "market failure" need to incorporate nonmarket values into public decision making

Accounting Framework

Framework	Method	Measure
Regional economics	**Input/output model**	**Jobs, income**
Benefit-cost analysis	**Microeconomics (supply / demand)**	**Net benefits, B/C ratio**

II. Montana Nonmarket Studies

1. Baseline research and methods (MT Bioeconomics Studies (1985-88); National Survey of Fishing, Hunting, and Wildlife-Associated Recreation; academic research)
2. Policy studies (endangered species recovery, water resource allocation, land allocation, wildlife management, pricing)
3. Litigation/(Clark Fork Superfund Case)

Examples of Montana Natural Resource Policy Applications

1. Kootenai Falls proposed dam
2. Upper Missouri R. water reservations
3. MT wildlife habitat acquistions (Brewer, Nelson, etc.)
4. Wolf recovery in YNP
5. MT State Lands Recreation Fee
6. MFWP nonresident elk permit prices
7. Rock Creek recreation mgt: float v. wade angler
8. Winter Use management in YNP
9. Bison and brucellosis management in YNP

Economic Uses of Fish and Wildlife Resources

- Direct Use
  - Consumptive: fishing, hunting, gathering and genetic resources
  - Non-consumptive: wildlife viewing
- Indirect Use
  - Inputs to production: bees and pollination services; elk and private range
- Passive Use
  - Existence, bequest

Type of Use and Valuation Methods

Use	Method
Direct	Market Revealed preference (travel cost) Stated preference
Indirect	Hedonic property values Factor inputs
Passive	Stated Preference (Contingent valuation, conjoint analysis, contingent ranking, etc.)

Brief History of Contingent Valuation

- 1947 – Hoteling letter to NPS
- 1950's – Davis application to Maine woods
- 1986 – "approved method" DOI NRDA reg
- 1989 – Mitchell and Carson text
- 1990 – Application to Exxon Valdez spill
- 1993 – NOAA "blue ribbon" panel
- By mid-1990's in excess of 1000 studies

Contingent Valuation Study Design Issues

1) Human sample population
2) Definition of the good (attributes)
3) Payment vehicle
4) Question format
5) Supplemental data
6) Analysis methods

Methods for several stated preference applications in MT

Example of **direct use** valuation:

Angler use of 17 Montana streams (including the Madison R. and Missouri R.)

Example of passive use and wildlife viewing:

Wolf recovery in YNP

Direct use v. passive use valuation

	Sample population	Payment vehicle
Direct use	Users: angler, hunters, visitors	Trip costs, access fee, etc.
Passive use	Households (and/or visitors)	Donation, referendum vote, taxes, etc.

III. CONSUMPTIVE USE

Contingent Valuation Question Format -Montana Stream Fishing

- Survey respondents are asked to describe their most current fishing trip
- Survey respondents were asked "… would you still have made the trip if your share of expenses had been [dollar bid amount] more?
- The bid amount was randomly varied from $1 to $500

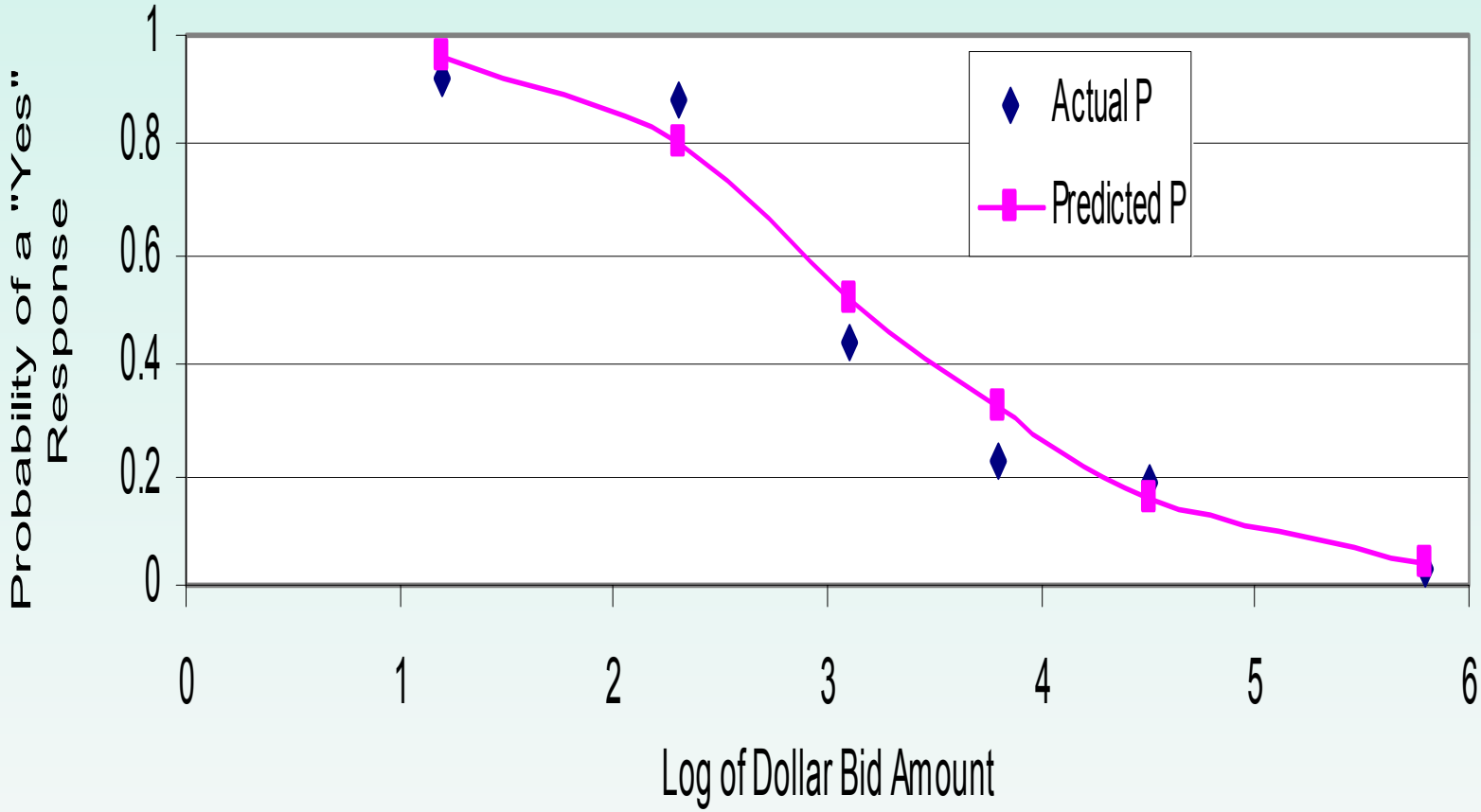
Source: Duffield and Allen 1988.

Summary of Responses to DC-CV Questions for Most Recent Fishing Trip

Dollar Bid Range	Missouri River Sample	
	"yes" / Sample	Ratio Yes
1-5	24/26	.92
6-15	22/25	.88
18-30	14/32	.44
35-50	7/30	.23
70-100	3/16	.19
150-500	1/27	.03

Source: Duffield and Allen 1988

Probability of a "Yes" CVM Answer for Missouri River Anglers

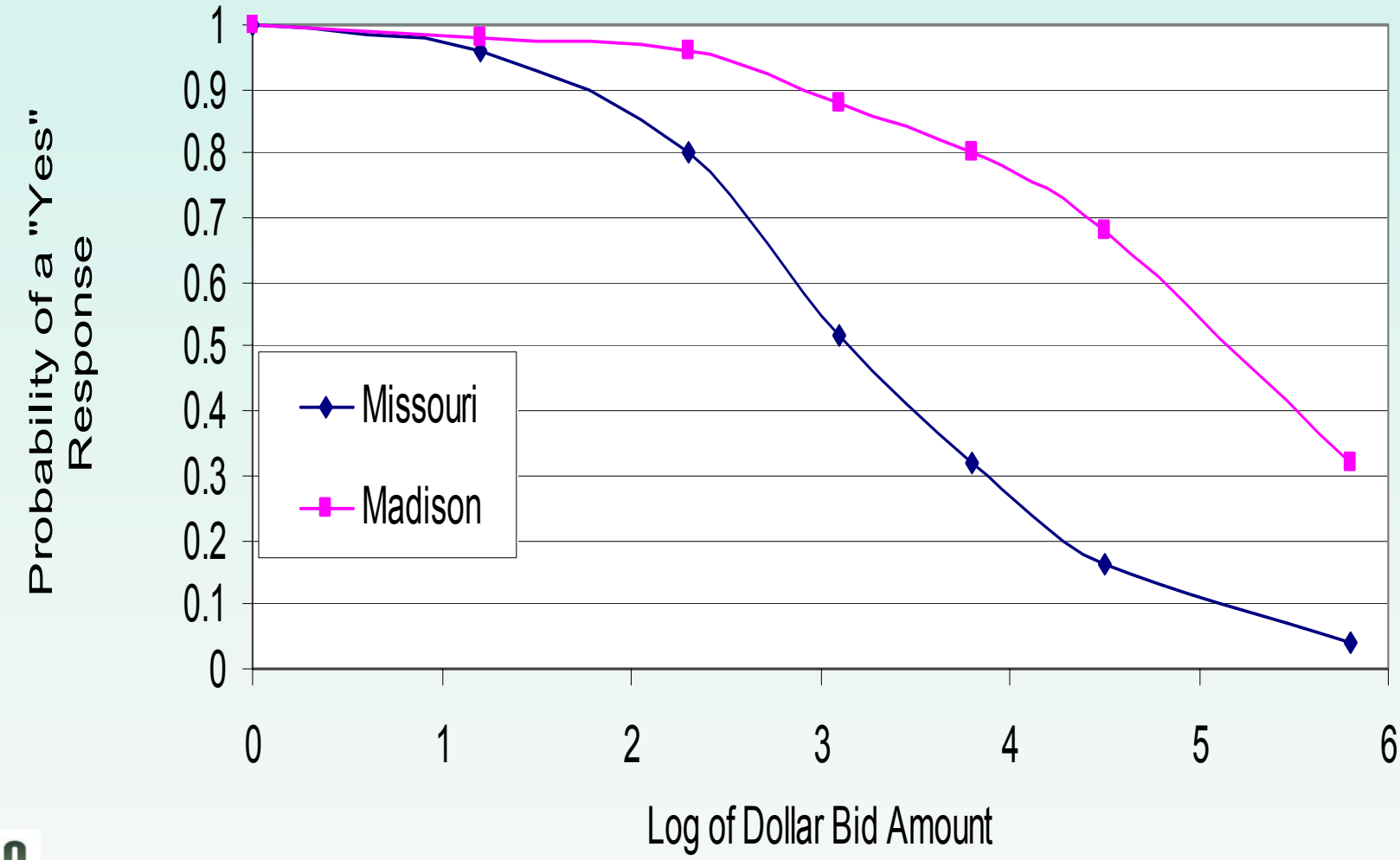


Summary of Responses to DC-CV Questions for Most Recent Fishing Trip

Dollar Bid Range	Missouri River		Madison River	
	Yes/Sample	Ratio Yes	Yes/Sample	Ratio Yes
1-5	24/26	.92	17/17	1.00
6-15	22/25	.88	18/22	.82
18-30	14/32	.44	23/29	.79
35-50	7/30	.23	22/32	.69
70-100	3/16	.19	15/22	.68
150-500	1/27	.03	5/24	.25

Source: Duffield & Allen 1988

Comparison of Missouri and Madison Rivers Angler CV Responses



Consistency of valuation responses with economic theory

Economic demand is a function of price, price of substitutes, income and preferences

Estimate demand models with these variables and examine sign and significance of:

- price response
- income elasticity
- relation to preference measures

Model specification: Dichotomous Choice Contingent Valuation Methodology

(1) $$\Pi(t) = \Pr(WTP > t) = 1 - F(t)$$

(2) $$\Pi(t;\tilde{x}) = \left[1 + \exp(-\alpha t - \tilde{\gamma}\tilde{x})\right]^{-1}$$

(3) $$L = \ln(p/(1-p)) = \alpha t + \tilde{\gamma}\tilde{x}$$

(4) $$M_T = \int_0^T [1 - F(x)]dx$$

(5) $$\eta_p(\tilde{x}) = \exp(-\tilde{\gamma}\tilde{x}/\alpha)[p/(1-p)]^{-1/\alpha}$$

Fitted CV Model of Willingness-to-pay for Most Recent Missouri R. Fishing Trip

$$\text{Ln}(P/(1-P)) = 2.55 - 1.63\ \text{LDOLAMT} + .323\ \text{LRCOT} + .902\ \text{LINCOME}$$

P	= probability of a yes response
LDOLAMT	= log of dollar bid amount
LRGCOT	= log of # of large trout caught this trip
LNCOME	= log of reported household income

(all coefficients are significant at 95% level of confidence or greater)

Source: Duffield and Allen 1988

General findings: Montana angler use values

-Differences in values across sites

-Some consistency across estimation methods

-User groups are heterogeneous

-Values vary across user groups

-Values similar to Alaska, another "destination fishery"

Estimated Value/Trip for Stream Fisheries in Montana (Duffield and Allen 1988)

River	Dollar Value / Trip		Ratio TCM/CVM	Sample Size	
	TCM	CVM		TCM	CVM
Madison	234	228	1.3	357	148
Up. Yellowstone	230	150	1.53	81	121
Boulder	180	149	1.21	57	69
Rock Creek	173	92	1.88	89	78
Big Hole	164	218	.75	187	140
Gallatin	161	180	.89	264	152
Blackfoot	142	133	1.07	149	97
Bighorn	121	159	.60	160	151
Beaverhead	112	188	.59	120	108

Estimated Value/Trip for Stream Fisheries in Montana (Duffield and Allen 1988)

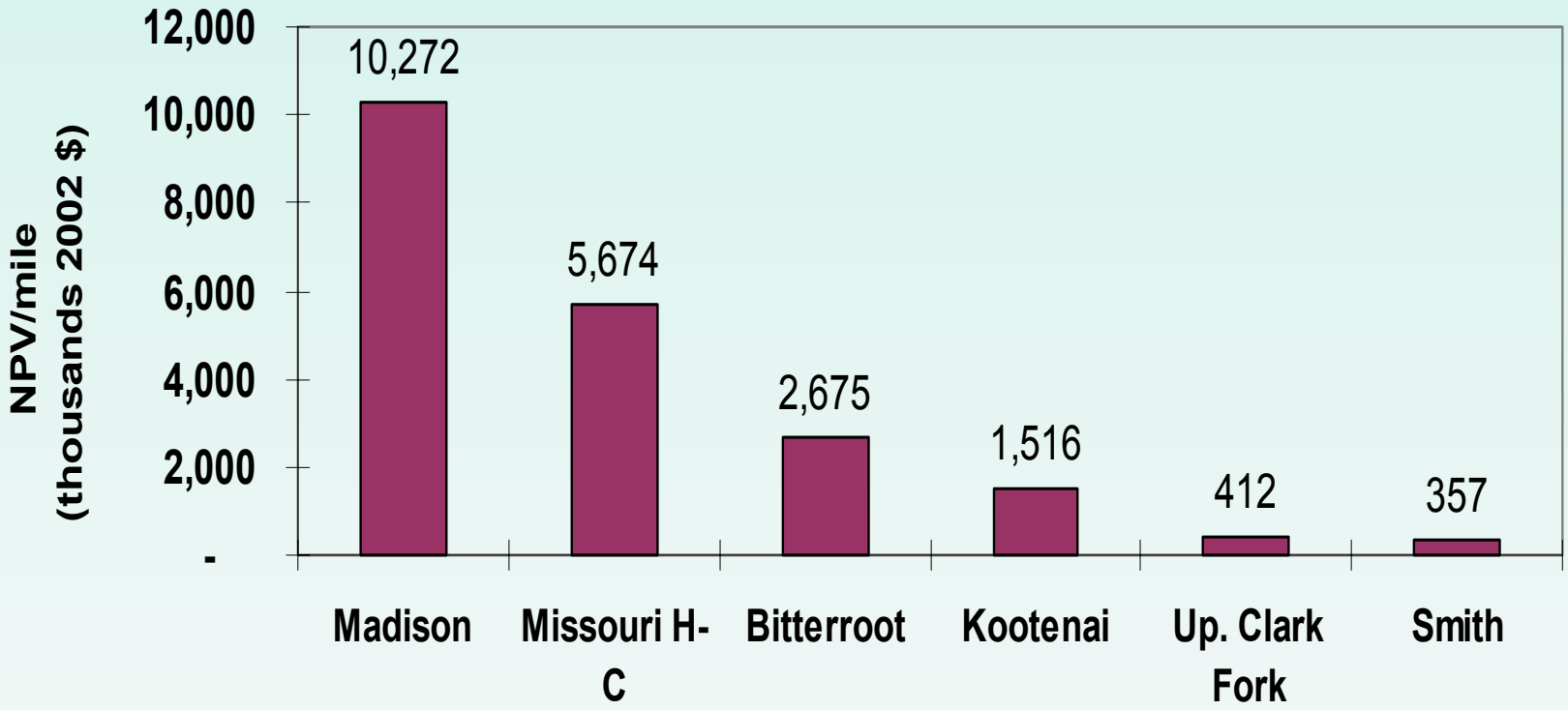
River	Dollar Value / Trip		Ratio TCM/CVM	Sample Size	
	TCM	CVM		TCM	CVM
Smith	94	153	.61	43	44
Stillwater	82	85	.96	133	113
Bitterroot	73	59	1.24	88	117
Md. Clark Fork	68	86	.79	231	126
Md. Yellowstone	63	74	.85	174	105
Missouri	60	63	.95	357	148
Up Flathead	56	99	.57	66	65
Kootenai	56	38	1.47	121	72

Correlation of Value per Trip Estimates for CVM and TCM Montana Angler Studies

Sample	Correlation Coefficient	
	Pearson	Spearman
Complete 17 River Sample	.7253 P=.000	.7132 P=.001
Subsample of 12 rivers with 80 or more observations	.7993 P=.001	.8112 P=.001

Source: Duffield & Allen 1988

Net Present Value per Mile of Angling on Montana Streams



Source: Derived from Duffield 1990.

Montana Stream Fishing Angler Types - 1986

- Survey data: 17 reasons for choosing to fish a given river on last trip (solitude, outdoors, family, catch large fish, catch many fish, close to home, eatinf trout, stc.)
- Cluster analysis generated 4 mean angler types
  - Nature generalists – outdoor, solitude, close to home
  - Fishing Generalist – catch large trout, wild trout, eat trout
  - Casual Anglers – not wild trout, close to home
  - Specialists – skills, large trout, outdoors

Source: Allen 1988a

Angler Types – Average Value for Recent Trip (1986 $)

- Nature Generalists $ 91
- Fishing Generalists $ 117
- Casual Anglers $ 8
- Specialists $ 170

Source: Duffield & Allen 1988 (DC-CVM Study)

Key Characteristics of Montana Angler Types (Allen 1988a)

Characteristic	Nature	Fishing	Casual	Specialist
Percent Resident	81	72	83	58
% Fishing Favorite Activity	20	22	14	30
% Used Flies	30	34	29	60
% Caught No Trout	15	14	34	15
% Belong to Sport or Conservation Group	23	28	19	43

Relative Values for Angler Use by Residency and Water Type, Upper Missouri River, Montana -1989

Water Type	Value per Trip		Value per Day	
	Resident	Non-resident	Resident	Non-resident
Rivers	147	793	52	193
Reservoirs	143	507	40	129
Resident sample includes only resident from the Upper Missouri River Sub-basin				

Source: Duffield, Neher, Patterson, and Allen 1990

Comparison of Alaska and Montana Angler Values

Study	User Group	Target Species / Resource	Net Benefit Est. per Day (1997 $)
AK – Carson et al. 1987	R & NR	Salmon	285
AK - Duffield & Neher 2002	NR	Grayling	217
AK	NR	Salmon	300
AK	R	Grayling	~50
AK	R	Stocked Lakes	15 – 44
MT – Duffield et al 1990	NR	U. Missouri R's	249
MT	NR	reservoirs	167
MT	R	U. Missouri R's	67
MT	R	reservoirs	52

General findings for Montana hunter valuation

- Values vary across: Species targeted, Residency status, User group

Relative values for Montana hunting by species targeted (1987-1993)

species	year of study	Value per trip	Value per day
deer	1986	108	55
antelope	1985	143	62
elk	1985	185	66
waterfowl	1989	168	89
moose	1993	550	183
Bighorn sheep	1993	800 to 1436	287 to 320

Relative values for Montana hunters by residency and species

species	Study year	Dollars per trip		Dollars per day	
		resid.	nonres.	resid.	nonres.
deer	1988	209	706	46	102
elk	1998	311	931	104	116
ducks	1989	126	329	79	100
sheep	1993	800	1436	320	287

Montana Elk Hunter Preference Study – Hunter Types

User Group	Mean Value / Trip
• Nature Hunter	$ 248
• Generalists	$ 300
• Meat Hunters	$ 165
• Trophy Hunters	$ 360

Source: Loomis, Cooper, and Allen 1988

Characteristics of Montana Elk Hunters

Characteristic	Nature	Generalist	Meat	Trophy
% Resident	72	69	88	48
% Hunting is Favorite Activity	13	22	12	21
% Used Guide	8	13	4	20
% Agree Vehicles only on Open Roads to Retrieve Game	59	60	39	51

Source: Allen 1988b

General findings on trends in values for direct use of fish and wildlife

- data is somewhat limited due to absence of consistent studies over time
- one data point is provided by Montana elk hunting studies in 1987 and 1998
- elk studies indicate increase in values, but separate trends for resident and nonresident are not clear
- another data point is a U.S./Canada meta-analysis for all types of outdoor recreation..also + trend.
- license sales data is a third source of information

Trend in Montana Elk Hunting Values

Year	User Group	Value per trip (1998 $)	Value per day
1987	All	380	53
1998	Residents	311	104
	Nonresidents	931	116
	All *	503	108
* Weighted 31% nonresident, 69% resident to match 1987 sample			

Source: derived from Loomis, Cooper and Allen 1988 and Brooks and King 2001.

Overall Trend in Outdoor Recreational Use Values from a Meta-analysis

- Data base of outdoor recreational use values 1967-98 in US and Canada
- 760 estimates, 163 studies, 21 recreational activities
- Estimated regression model with 26 significant variables, adjusted R-square =0.27
- "Trend" is statistically significant, implies benefits increase faster than inflation at about $1.00 per year per activity day per person.

Source: Rosenberger and Loomis, 2001

Markets for hunting and fishing permits

- Permit sales also provide value information (year or season value rather than site-trip)
- Consistent year to year data for trend analysis
- response to standing offer of right to hunt or fish for a known price

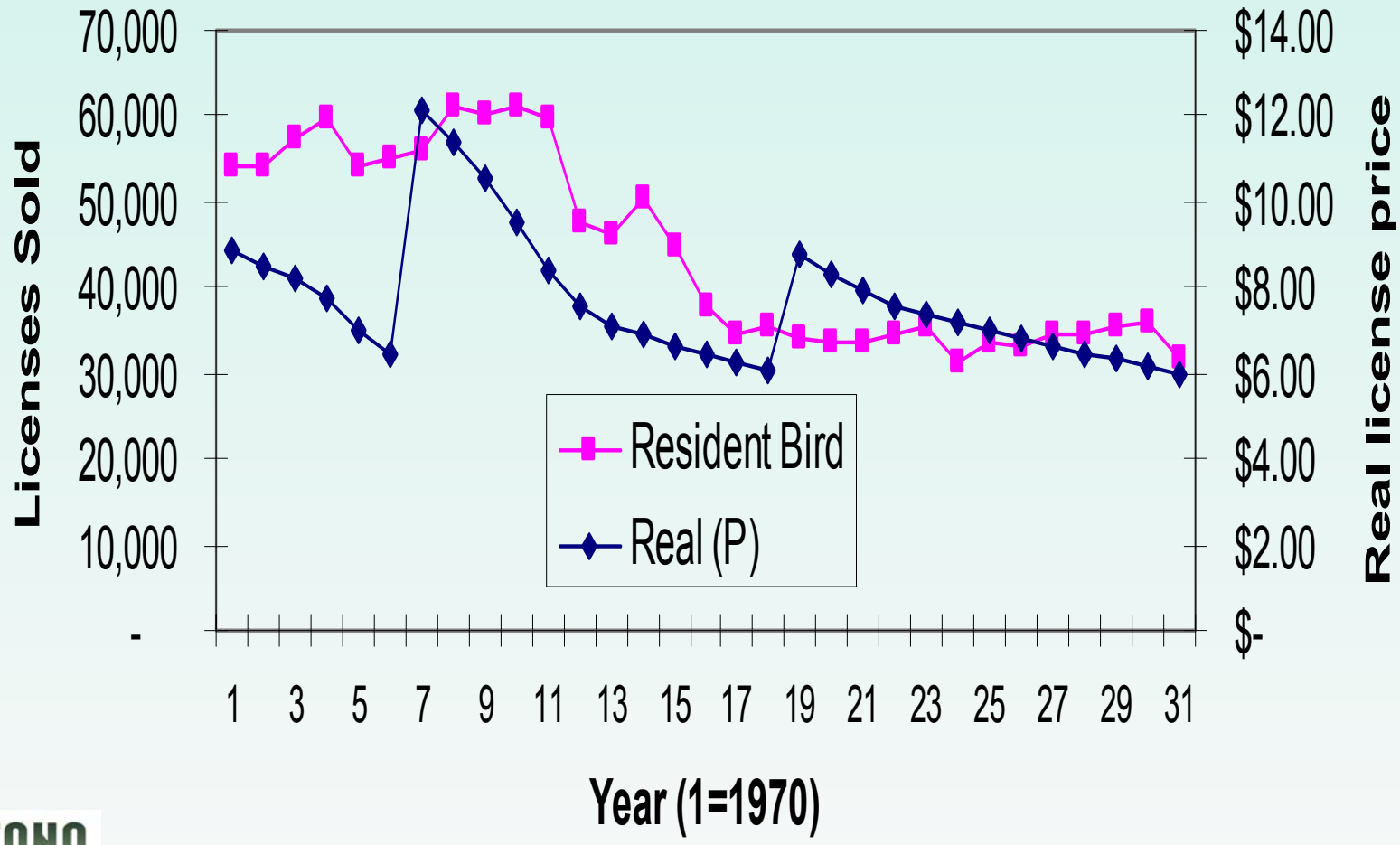
Insights from hunting and fishing permit markets

1. Demand for resident consumptive use is roughly stable to declining.
2. Demand for nonresident consumptive use has been increasing significantly
3. Resident demand is highly price inelastic and priced well below revenue max. price
4. Nonresident demand is more price elastic but significant + demand shift over time
5. Prices are not a significant factor for: MT nonresident fishing

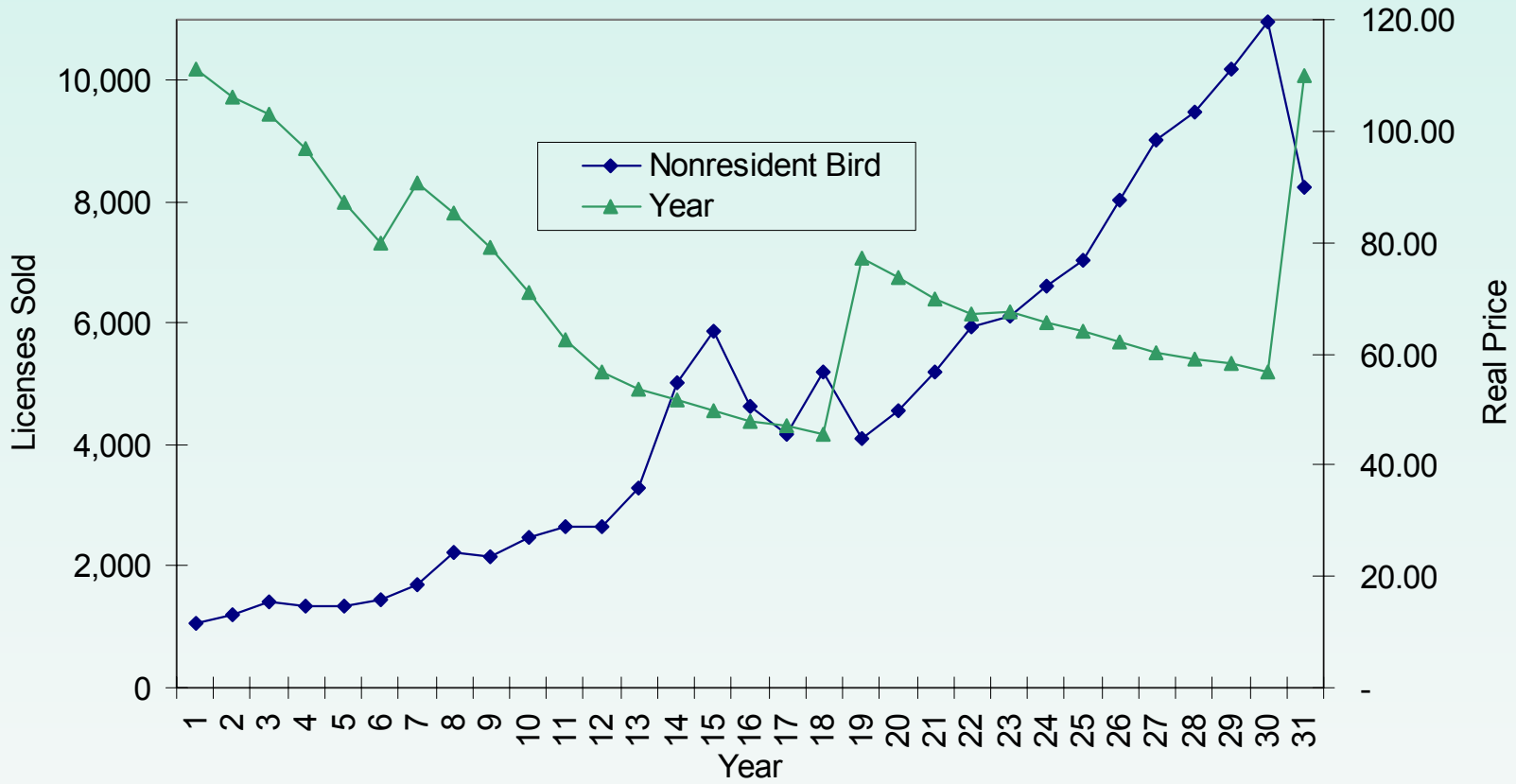
Permit Market Information on Montana Big Game Hunting Values

Species	Residents	Nonresidents
(A) Current permit price (2003)		
Elk	16	578 – 925
Deer	13	328 – 775
Antelope	14	203
Moose	78	753
Mountain goat	78	753
Bighorn sheep	78	753
(B) Auction price (1991-95)		
Bighorn sheep	$61,000 to $310,000	
Moose	$4,000 to $14,000	
(C) Landowner fees (1992)		
Per animal	50 to 200	
Per hunter	10 to 1000	

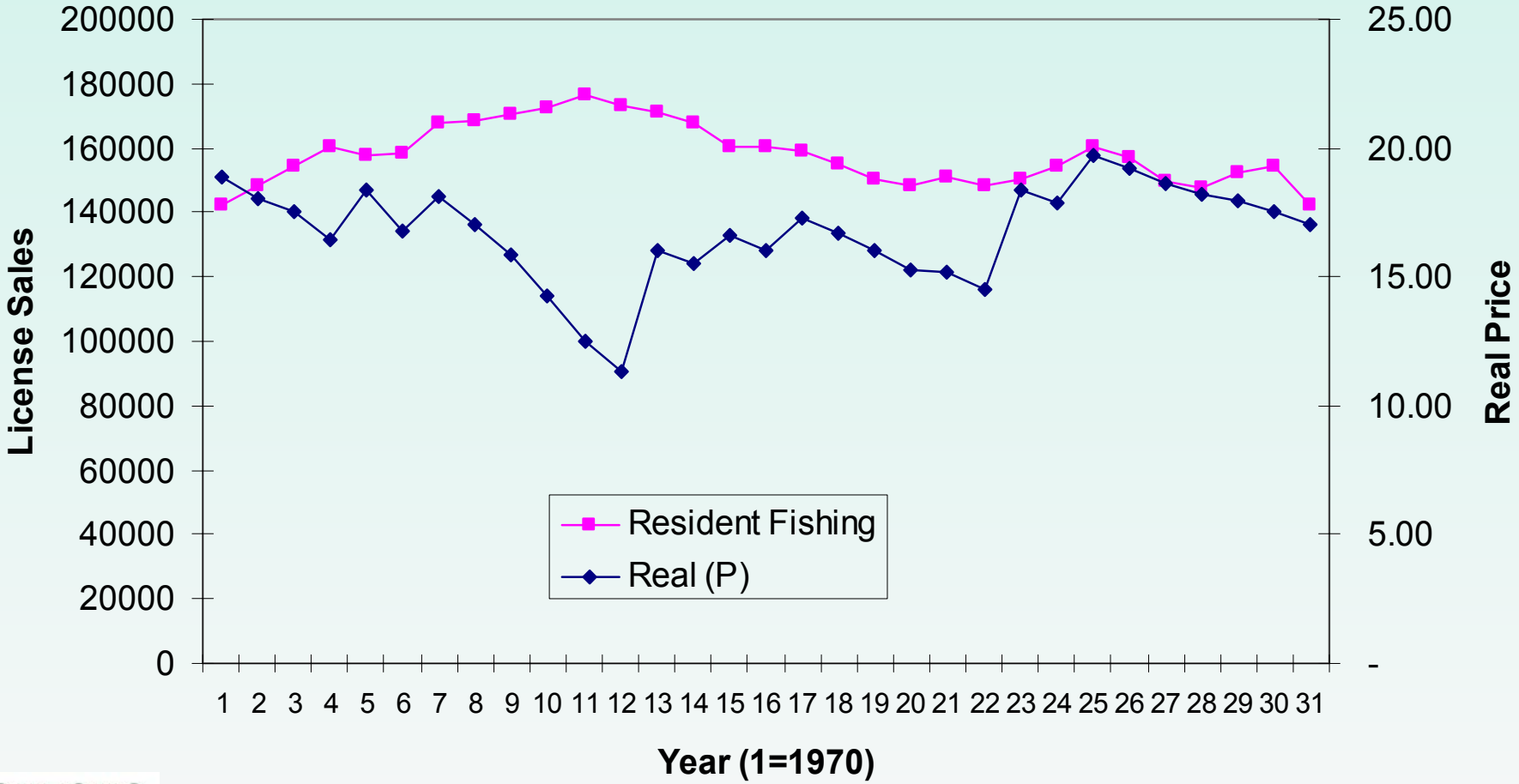
Plot of Resident Bird License Sales and Real Price:1970-2000



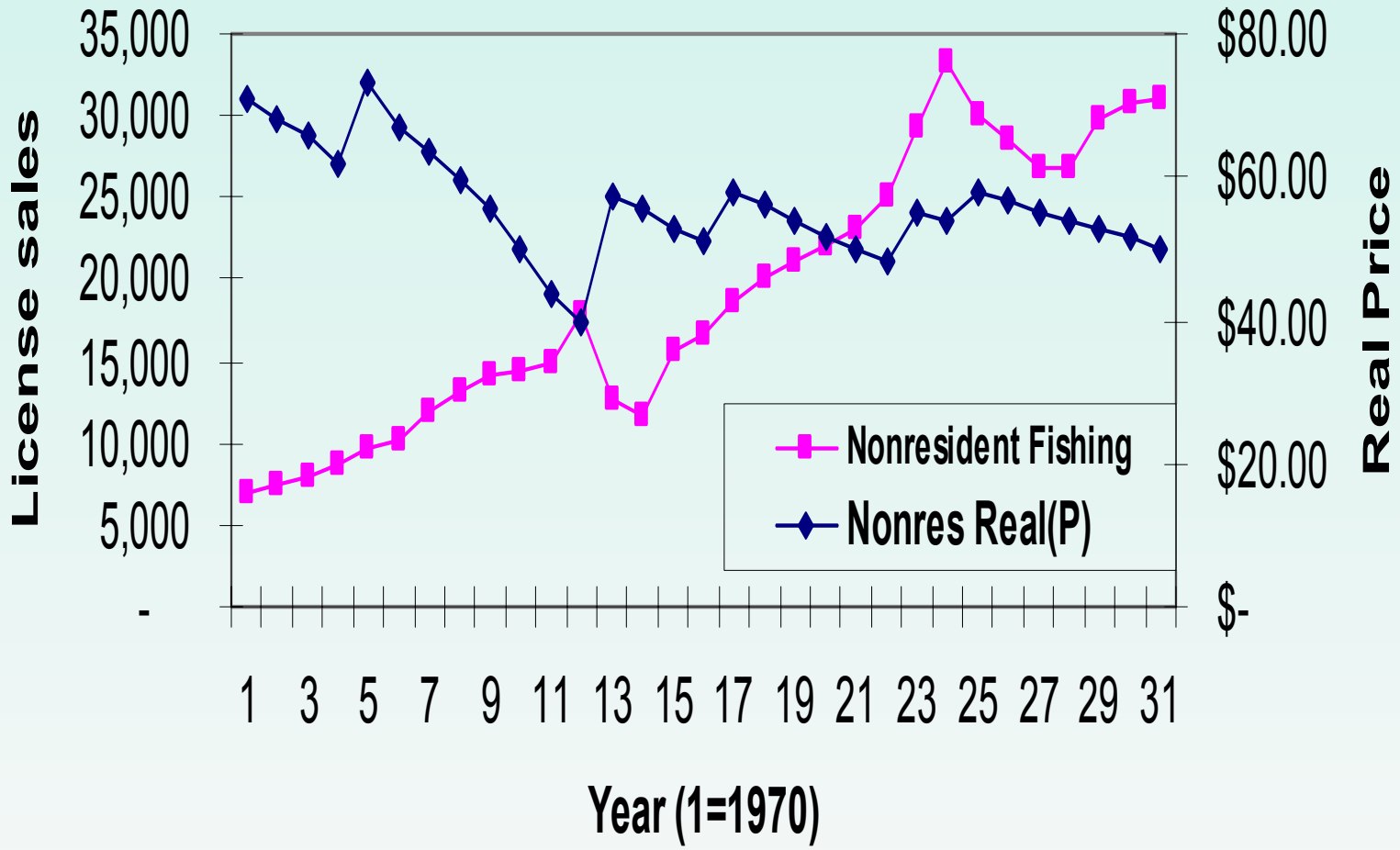
Plot of Nonresident Bird License Sales and Real Prices: 1970-2000



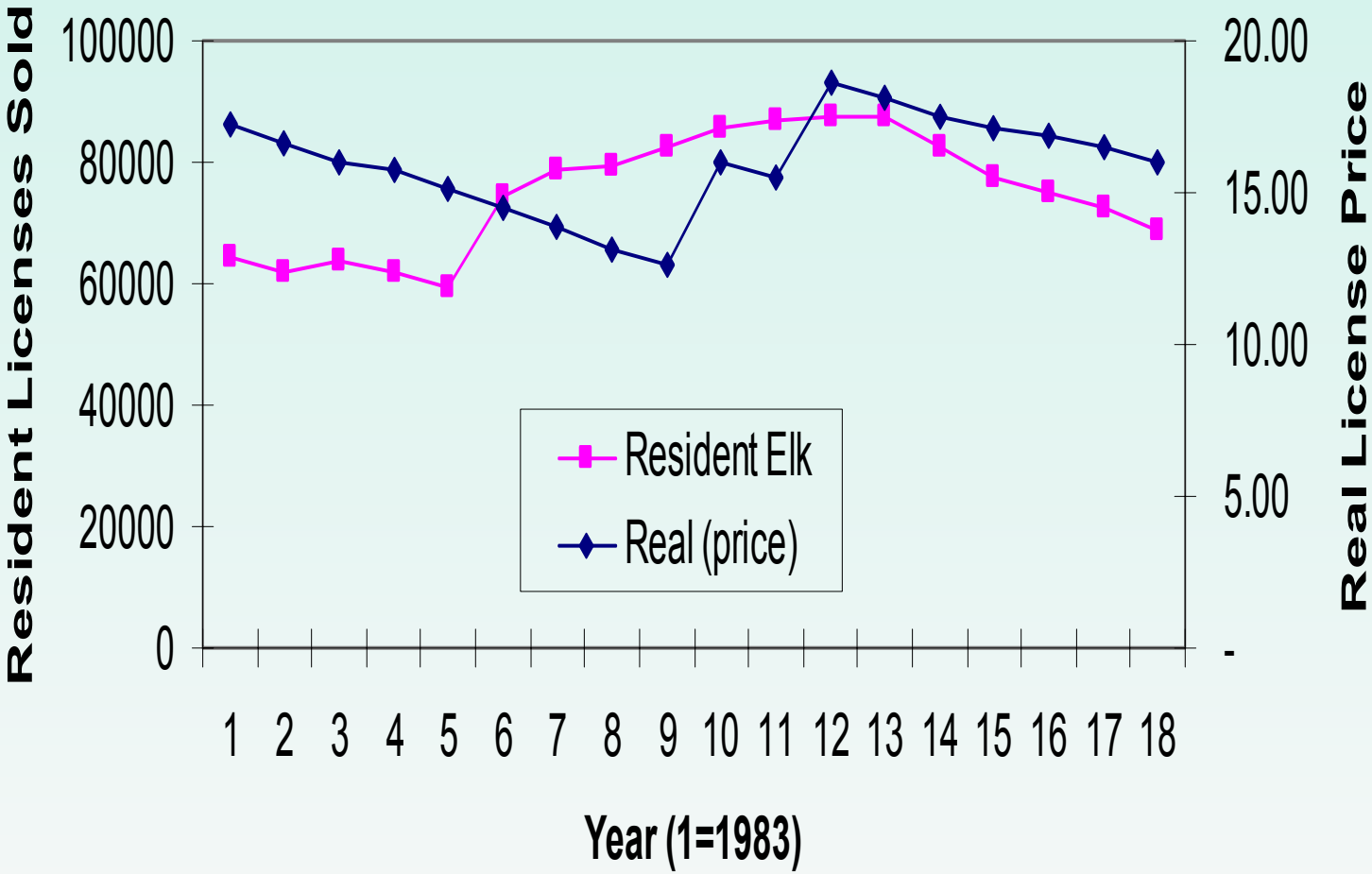
Plot of Montana Resident Fishing License Sales and Real License Prices: 1970-2000



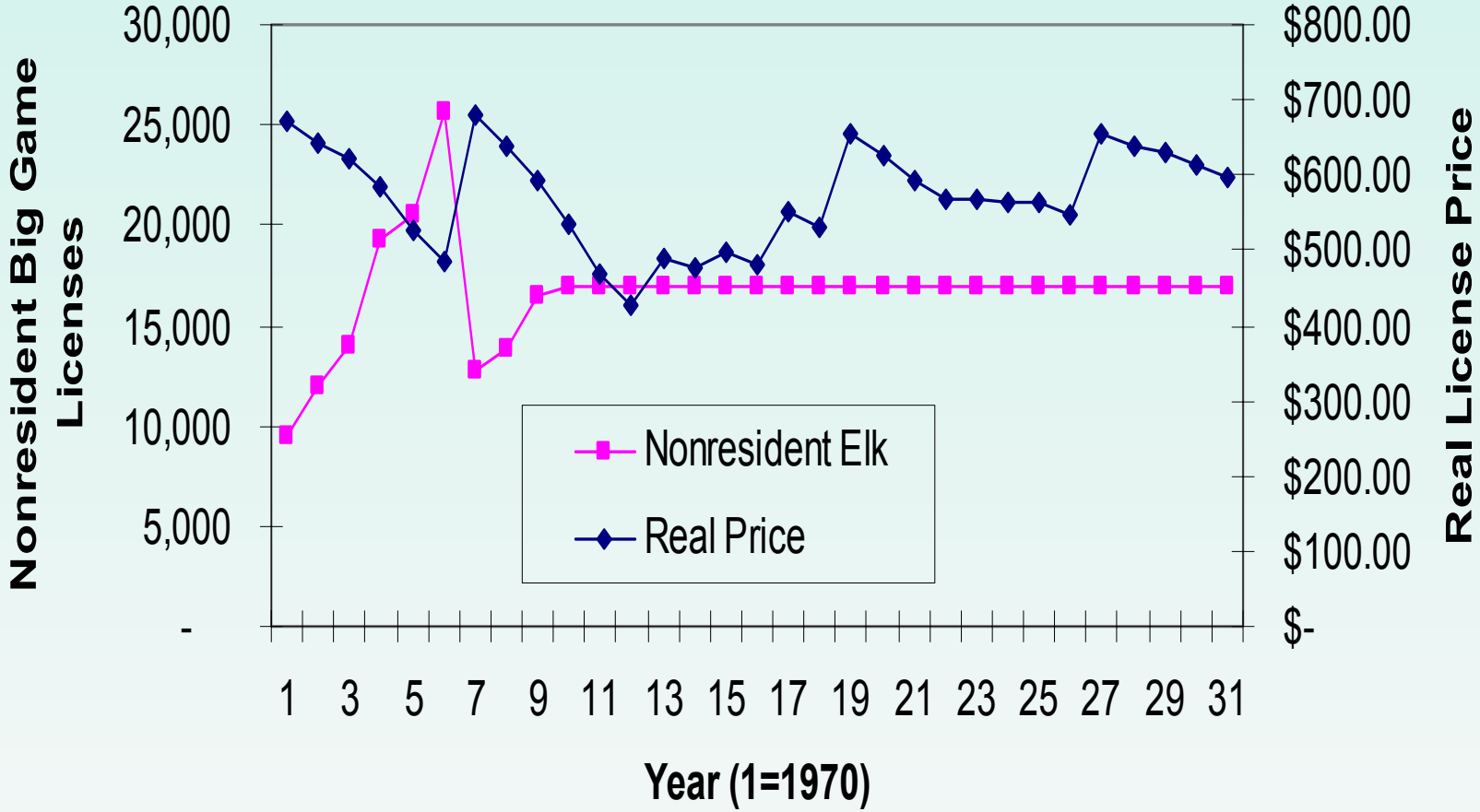
Plot of Nonresident Season Fishing License Sales and Real Price:1970-2000



Plot of Resident Adult Elk License Sales and Real License Price: 1983-2000



Plot of Nonresident Elk License Sales in Montana and Real Price:1970-2000



Estimated Model of Demand for Montana Nonresident Elk Hunting Permits: 1970-1988

ln (Elk Permits) = 19.12 + .044 ln (trend)
- 2.41 ln (price)

All coefficients are significant at the 99% level of confidence or greater

Adjusted R-square = .924

Comparison of consumptive and nonconsumptive values for fish and wildlife uses in Montana

- Only consistent data source is National Survey of Fishing, Hunting and Wildlife-associated Recreation
- State-level data not available for all years
- 1996 data shows wildlife viewing values per day for region similar to fishing values and about one-half of hunting values
- Values on a year basis similar for all uses
- Average estimates obscure considerable diversity in both consumptive and nonconsumptive uses

Relative Values for Fishing, Hunting and Wildlife Viewing

Region	Per Year	Per Day
(A) Trout Fishing		
Mountain	268	27
(B) Hunting		
Mountain (deer)	301	58
CO, ID,MT,OR, WY (elk)	410	59
Alaska (moose)	624	61
(C) Wildlife Viewing		
Pacific	263	19
Mountain	312	31
Alaska	696	34

Source: 1996 National Survey of Fishing, Hunting, and Wildlife Associated Recreation

Example of direct use policy anaysis: U. Missouri water reservations 1991

- Comparison of economic value of instream flow uses (recreation, hydro-electric) and proposed irrigation project withdrawals
- Of 219 irrigation projects, found 157 to have values less than instream uses
- Net loss per year to irrigation allocation v. instream flow allocation $186 million

Source: Duffield, Neher, Patterson, Allen 1990; Montana DNRC 1991

Example of direct use regional economic analysis: Brewer Ranch acquisition

- Economic impact of wildlife habitat acquisition (HB 720, 1989) for 88,000 acre sagebrush-grassland in Broadus area (SE Montana)
- Block management (public access) v. fee hunting
- Relative hunter density Region 7 block management (3.51/sq mile) v. fee hunting (0.15)
- Region 7 percent nonresident hunters (20%) versus block management (68%)
- Public access impacts $223,000/yr, fee $40,000
- Benefits $2.3 to $3.2 million, purchase $1.2 m.

Source: Duffield 1989.

Example of applying direct use values to a fishery management conflict: Rock Creek bank and float anglers

- Mid-1970's boat traffic essentially nil
- By 1988 20.4% of May-June use is float
- Potential for conflict on this small river
- Policy analysis:
  - current fishing values, quality change
  - net benefit change if eliminate boaters
  - angler opinions

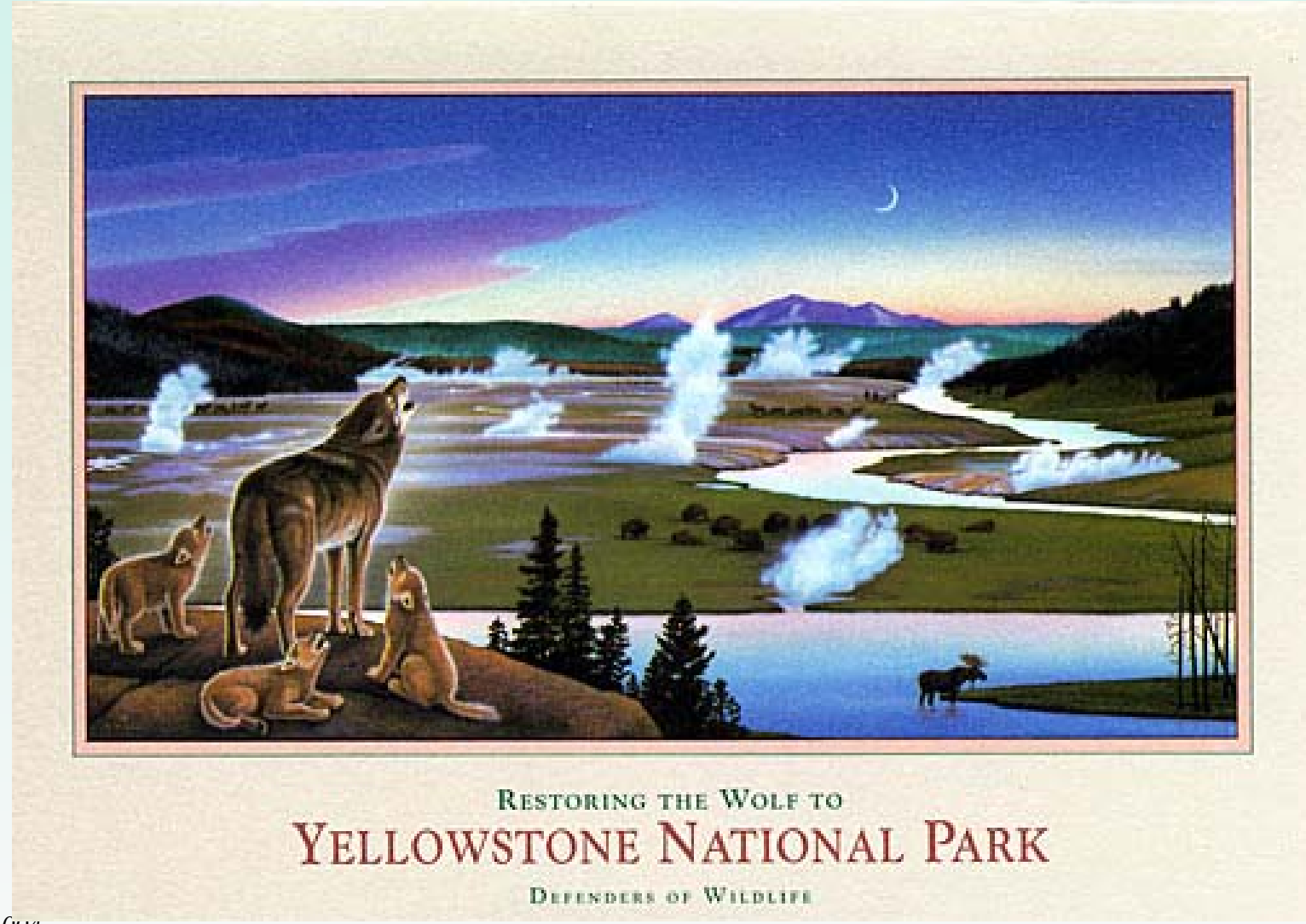
Source: Duffield 1989

Results of Rock Creek Analysis

- Current trip value $218 (not sig. diff. from 1986)
- Bank angler trips $211
- Float angler trips $289 (5.3 hrs/day & 1.8 days/trip both groups)
- No significant value on improved fishing quality. Trip values drop significantly with lowered fishing quality.
- If float fishing were eliminated:
  - Bank angler trips + $27 (not significant)
  - Float angler tips - $243 (significant)
- Would be a net loss in fishing benefits if float fishing were eliminated (about a 20% reduction in net benefits)

Source: Duffield 1989

IV. WILDLIFE VIEWING AND PASSIVE USE



Wolf recovery in Yellowstone NP.

- Estimates draw on both visitor and household population samples
- Studies conducted prior to restoration
- Data was relied on for Draft and Final EIS on wolf recovery in YNP and central ID
- Both benefit/cost and regional economic impacts investigated
- Values both for supporters and opponents

General characteristics of YNP visitor use of wildlife

- Wildlife observation is the top motive for visiting Yellowstone (94 %) (geological features are next most important 77 – 87 %)
- Visitors have well-defined and stable preferences for viewing wildlife
- These preferences are similar across in and out-of-region residents

Source: Duffield 1992; Duffield, Patterson, and Neher 2000

Order of preference to see animals in YNP: Regional v. Out-of-region residents

rank	Nonres.	Percent	Resident	Percent
1	grizzly	0.524	grizzly	0.611
2	moose	0.330	black bear	0.377
3	black bear	0.314	moose	0.339
4	Sheep	0.245	elk	0.283
5	Elk	0.219	lion	0.256
6	Lion	0.217	sheep	0.156
7	Eagle	0.203	bison	0.150
8	Bison	0.165	eagle	0.144
9	Wolf	0.165	wolf	0.133
10	wolverine	0.038	wolverine	0.077

Source: Duffield 1992

Order of preference to see animals in YNP: 1990 v. 1999 visitor samples

rank	1990	percent	1999	percent
1	grizzly	0.550	grizzly	0.58
2	black bear	0.332	wolf	0.36
3	moose	0.332	moose	0.35
4	elk	0.239	lion	0.31
5	lion	0.229	black bear	0.29
6	sheep	0.219	sheep	0.23
7	eagle	0.187	eagle	0.21
8	bison	0.160	bison	0.19
9	wolf	0.154	elk	0.14
10	wolverine	0.047	wolverine	0.06

Source: Duffield, 1992; Duffield, Patterson, and Neher 2000.

Wolf Restoration Policy Issues

- Wolves exterminated in West by 1930
- Aldo Leopold suggested YNP wolf recovery 1944
- USFWS proposals for wolf recovery in early 1980's
- Congress authorized Yellowstone/central Idaho wolf recovery EIS in 1991
- Benefits: complete ecosystem, wildlife viewing
- Costs: predation on livestock, impacts on prey species (elk, deer, moose) and hunters, management costs
- Research question: is society better off with wolves?

Question Sequence - Wolves

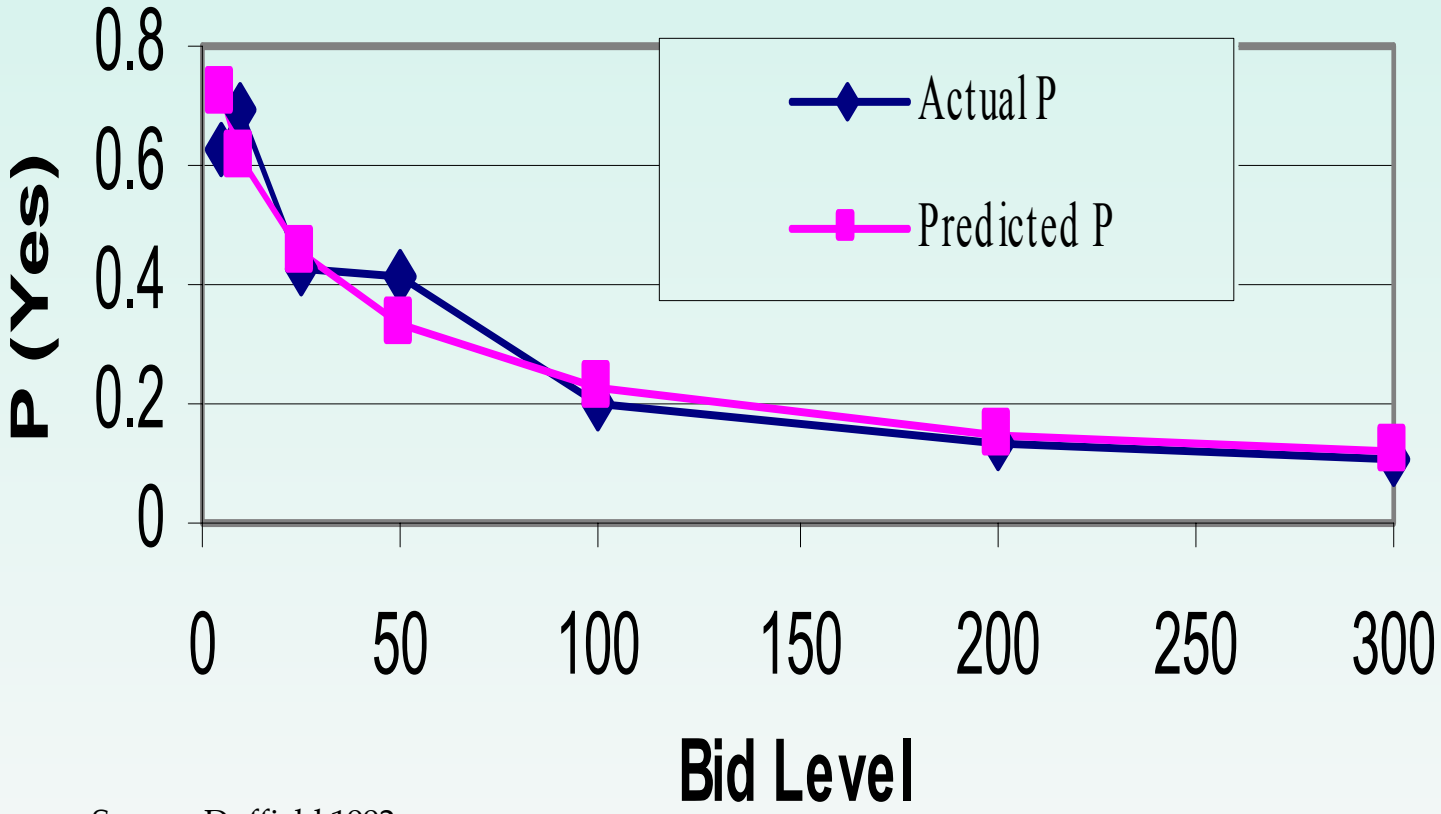
- Respondents asked to assume:
- Trust fund is essential for wolf recovery
- Respondent might see or hear wolves
- Donors have satisfaction of knowing woves are present in Yellowstone NP
- Valuation question: "If you were contacted in the next month, would you purchase a lifetime membership in a trust fund for $ Bid amount to support wolf recovery in Yellowstone NP?"
- Bid varied randomly $5 to $300 across surveys.

Aggregate responses to Dichotomous Choice CV Question on Contribution to trust Fund to Support Wolf Recovery

Bid level	N	"Yes" responses	Actual probability	Predicted probability
$5	54	34	.63	.72
$10	48	33	.69	.61
$25	81	35	.43	.45
$50	95	40	.42	.33
$100	133	27	.20	.23
$200	94	12	.13	.15
$300	81	9	.11	.12

Source: Duffield 1992

Plot of Actual and Predicted Probabilities of a "yes" Response to Wolf Trust Fund CV Question



Source: Duffield 1992

Estimated Net Economic Benefits Per Respondent for Bivariate Logistic Models for Wolf Recovery Trust Fund (1990$)

Welfare measure	MT,ID, WY residents	Out-of-region residents	All
(A) Trust fund responses for wolf recovery total valuation			
Median	$15.38	$20.27	$18.68
(B) Trust fund responses for wolf existence value			
Median	$6.64	$14.20	$11.50

Source: Duffield 1992

Multivariate Logistic Model of Wolf Recovery trust Fund Response (Total Valuation) (Duffield 1992)

Variable / Statistic	Entire Sample	Residents	Nonresidents
Constant	-31.39	-34.56	-32.48
Log of bid amount	-0.984	-1.314	-0.918
Log of gross family income	0.4631	0.548	0.484
Log of 1-4 index of familiarity with trust funds	1.345	--	1.263
Log of composite variable related to desire to see wolves	3.589	7.594	2.764
Log of composite of environmental attitude variables	7.30	6.57	7.99
Dummy for high preference to see deer, elk or moose	-0.336	--	-0.336
Dummy for “hunts big game”	-0.522	-1.62	--
Sample size	524	158	366
Hosmer-Lemeshow P-value	0.86	0.896	0.133

Estimated Mean Values of Wolf Reintroduction in the Yellowstone Area

Welfare measure / statistic	3-state region (WY,MT,ID)	Out of region	All US residents
Mean value for supporters	$20.50	$8.92	
Mean value for opposed	$10.08	$1.52	
Population of supporters	391,202	50,152,416	
Population of opposed	340,522	25,774,280	
Aggregate NEV/year	$321,201	$28,572,785	
Scaler	0.286	0.286	
Estimated NEV per year (Standard Error)	$91,863 ($9,179)	$8,171,817 ($811,470)	8,263,680 ($811,522)

Source: Duffield and Neher 1996

Annual Social Benefits and Costs of Yellowstone Wolf Recovery

Benefit or cost category	Annual value in thousands of 1992 dollars	
	Low estimate	High estimate
(A) Benefits: Annual NEV of reintroduction	$6,673.1	$9,854.3
(B) Costs:		
Foregone value to hunters	187.3	464.9
Value of livestock losses	1.9	30.5
Annual wolf management cost	441.0	441.0
Total costs	630.2	936.4
Net benefits of wolf recovery	6,042.9	8,917.9

Source: Duffield and Neher 1996

Wolf Recovery Policy Study

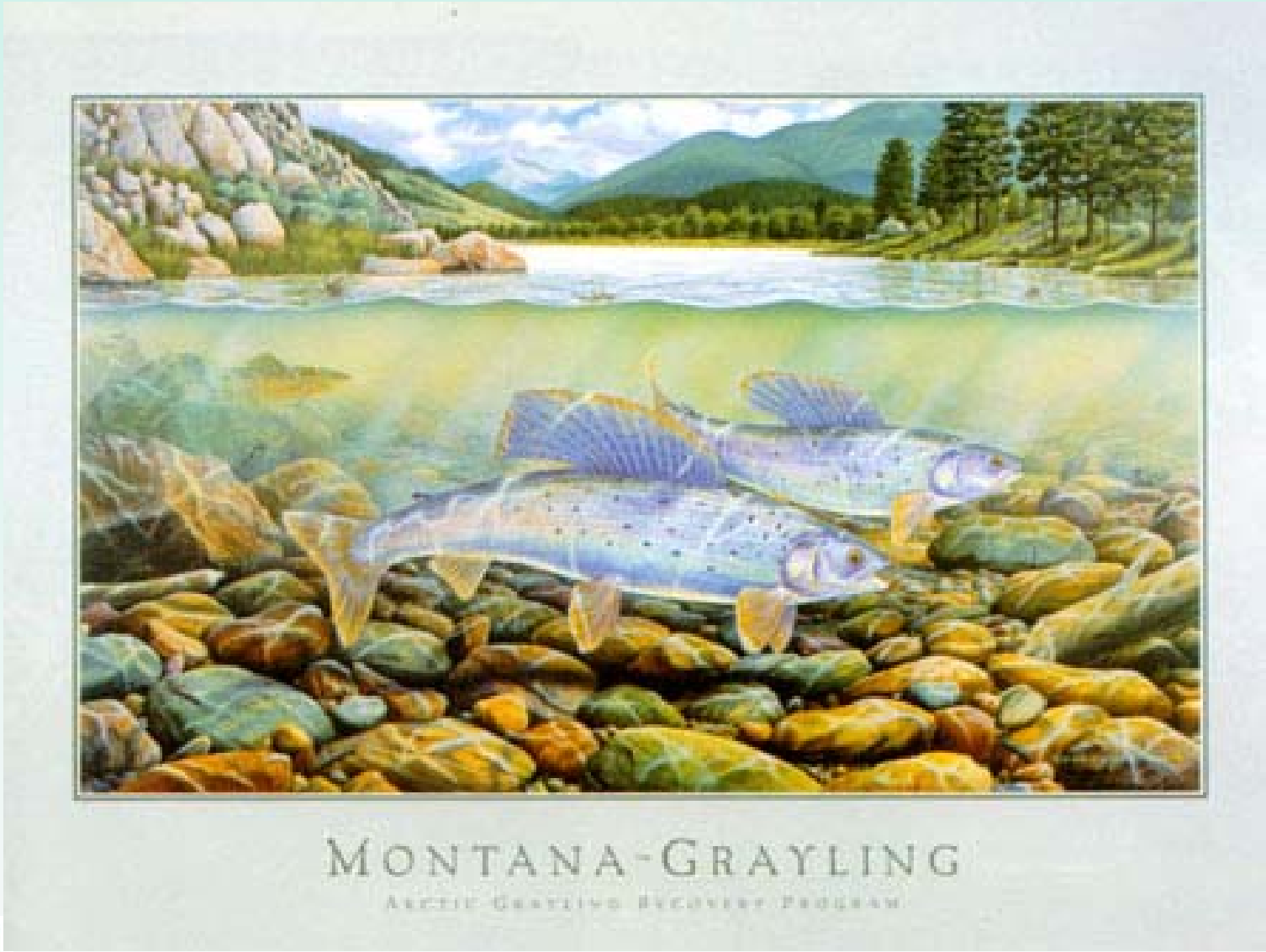
- General finding: Policy conclusions are sensitive to the definition of the extent of the relevant spatial market
  - YNP is a regional resource B/C < 1
  - YNP is a national resource B/C >> 1

Wolf recovery benefit-cost outcome: Regional v. National (1000 1992 dollars)

Item	Regional	National
Benefit	92	8,263
Cost	783	783
Net Benefit	(691)	7,480

Source: Duffield and Neher 1996.

Validating Passive Use Estimates



Example of Validation Study Investigating Passive Use Values

- Cash transactions experiment
- comparison of hypothetical and cash donation request
- Nature Conservancy trust fund payment vehicle, one-time request
- To augment instream flows for two Montana threatened fish

Arctic Grayling / Yellowstone Cutthroat Sample Size and Response Rate

Subsample	Delivered	Returned	
		N	Percent
A) Residents			
Cash –TNC	2,278	205	9.0
Hypo – TNC	1,013	193	19.1
B) Non-residents			
Cash –TNC	2,372	306	12.9
Hypo – TNC	1,054	288	27.3

Source: Duffield and Patterson 1991

Arctic Grayling / Yellowstone Cutthroat Frequency Distribution of Contributions

Subsample	N	Percent by dollar amount				
		10	25	50	100	250
A) Residents						
Cash –TNC	26	54	42	4	0	0
Hypo – TNC	60	75	18	7	0	0
B) Non-residents						
Cash –TNC	136	41	35	17	6	1
Hypo – TNC	157	39	36	17	8	1

Source: Duffield and Patterson 1991

Arctic Grayling / Yellowstone Cutthroat

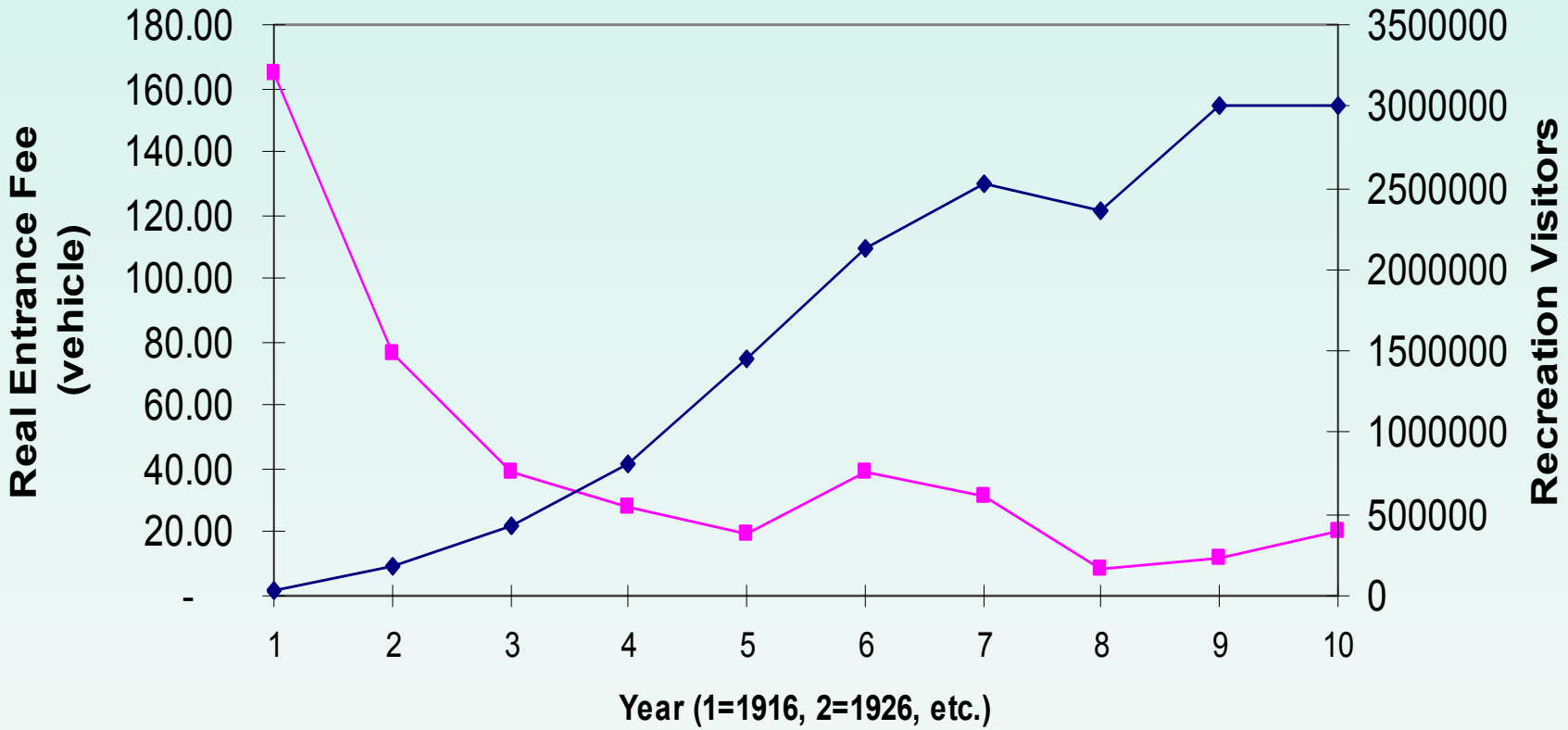
Sample	Average WTP per contributor	Average WTP per respondent
A) Residents		
Cash –TNC	17.69	2.24
Hypo – TNC	14.92	4.64
B) Non-residents		
Cash –TNC	28.43	12.60
Hypo – TNC	31.85	17.36

Source: Duffield and Patterson 1991

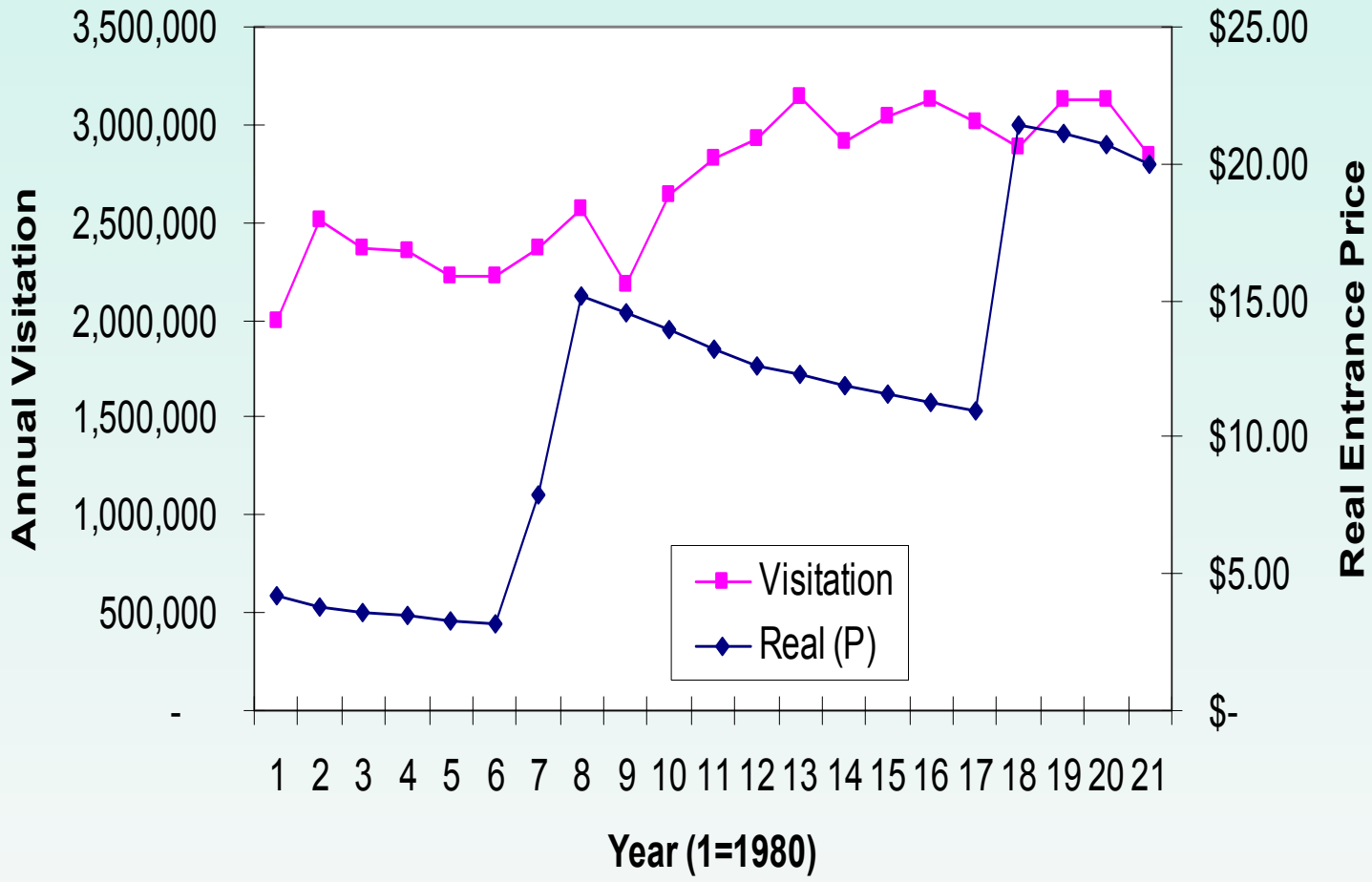
Insights from entrance fee data for Yellowstone NP

- Long term decline in real entry fee and increase in visitaton
- In constant (year 2001) dollars entry in 1916 was about $160
- Fitted model 1980-2001 (period of several significant fee increases..e.g. doubling from $10 to $20 in mid-1990's)
- Highly significant trend; very insignificant price response
- Revenue-maximizing price is hundreds of dollars

Plot of Yellowstone NP Real Entrance Fee and Visitation: 1916-2002



Plot of Real Entrance Price and Visitation to Yellowstone NP: 1980-2000



YNP wolf recovery analysis part II: regional economic impacts

- Visitors in 1991 survey asked how wolf presence would affect their visitation
- Responses indicated about 5 percent increase overall
- Predicted direct expenditure change of $19 million and total impact about $40 million
- Visitor responses in 1999 survey indicated that increase due to wolves about 3.4 %

Whether the Possibility of Seeing Wolves Affected Decisions to Visit YNP

Question/ Response	Winter Visitors	Summer Visitors	
		Residents	Nonresidents
(A) Was seeing or hearing wolves one of the reasons for making the trip to the Greater Yellowstone Area?			
Yes	35.9%	41.6%	42.0%
No	64.1%	58.4%	58.0%
(B) If yes, would you still have made this trip even if wolves were not present in the GYA?			
Yes	27.3%	30.7%	33.6%
No	**3.7%**	**3.6%**	**3.3%**
Not Sure	4.9%	7.2%	5.0%

Source: Duffield et al. 2002

Estimated Economic Impact of Wolf Viewing in Yellowstone NP

- **Percent who only visit if wolves ~3.4%**
- **Total non-resident Visitors to YNP 1.8 mil.**
- **Number visitors due to wolf presence ~60,000**
- **Nonresident spending per trip $291.21**
- **Direct expenditure due to wolves $17.5 mil.**

- **Total 3-state economic impact ~$35 million**

Example of economic impact analysis on a gateway community: YNP winter use policy and West Yellowstone

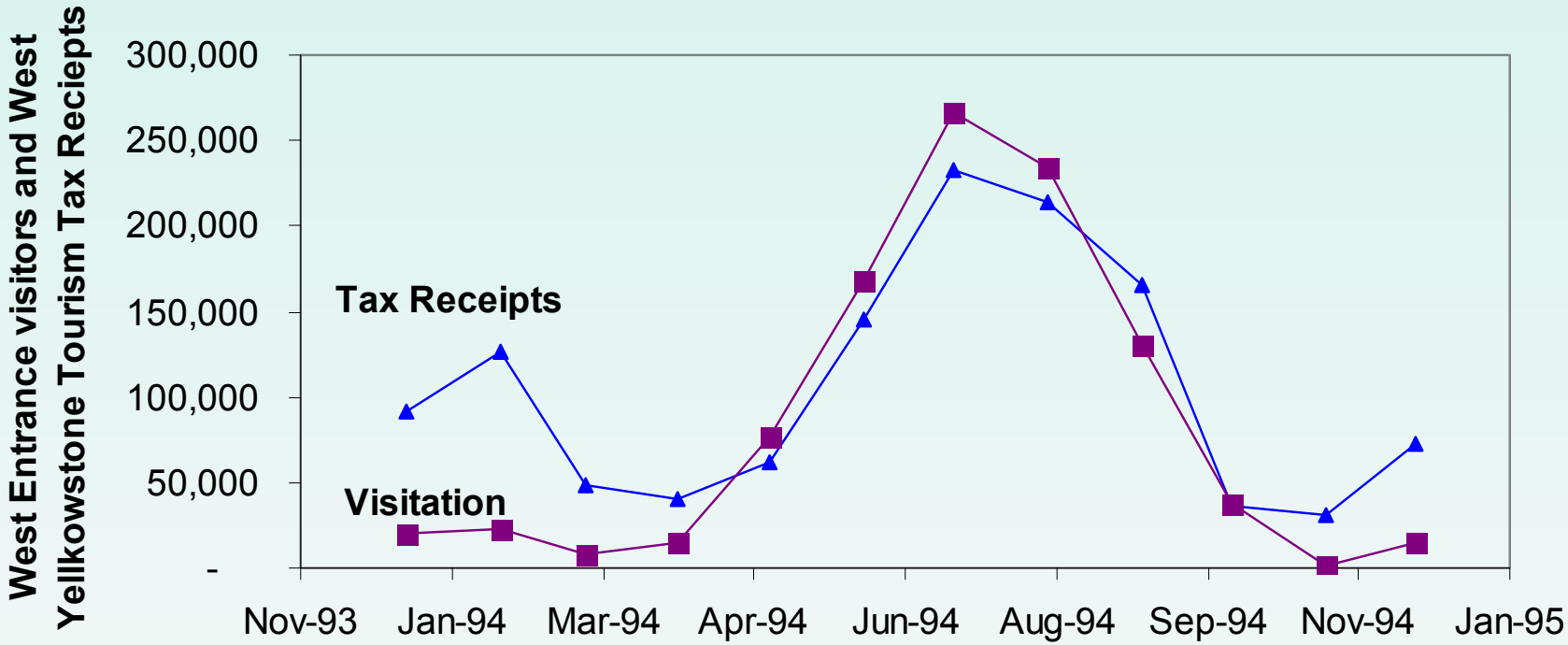
- Prior to recent lawsuit, new YNP winter use policy was to phase in a ban of snowmobiles
- Gateway communities, particularly W. Yellowstone predicted dire consequences
- Economic analysis indicated likely impact on West would be the loss of one year's growth in a steadily growing economy

Winter Visitation Responses to Closing YNP and GT to Snowmobiles

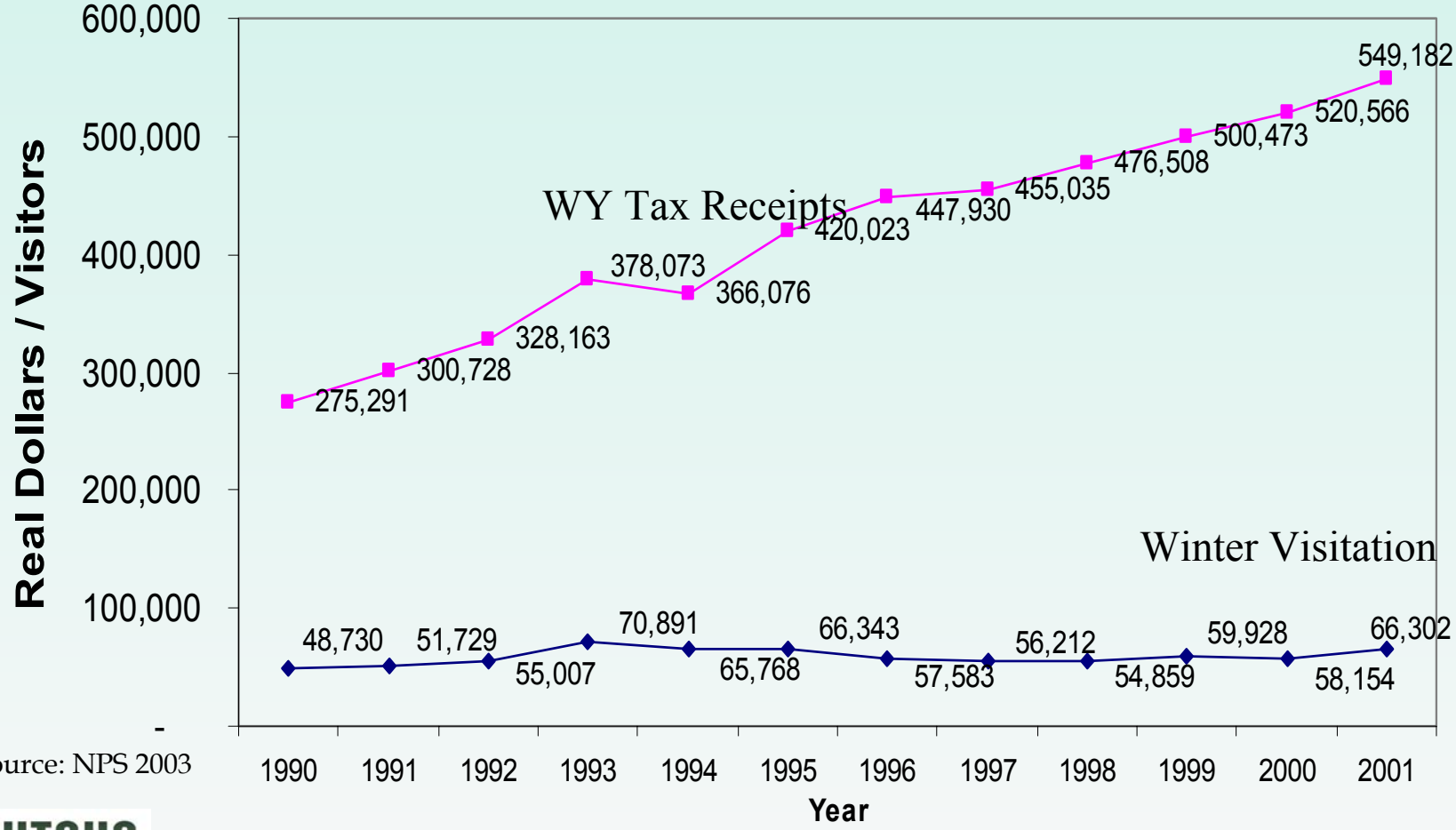
Response	Snowmobiles	X-C Skiers	Snowcoach
No Change	17.8	37.2	42.5
Would visit less frequently	59.6	12.0	14.1
Would visit more frequently	5.6	33.7	22.8
Would visit the same	4.2	6.5	7.8
Not sure	12.8	10.7	12.8

Source: Duffield and Neher 2000

Comparison of West Yellowstone MT Resort Tax Receipts and West Entrance Visitation



Comparison of West Yell. Winter Resort Tax Receipts and West Entrance Visitation



Source: NPS 2003

Predicted Impact of Snowmobile Ban on West Yellowstone Economy

- YNP FEIS estimated 33% drop in winter visitation due to snowmobile ban
- Winter visitor spending accounts for 25% of annual West Yellowstone visitor spending
- Ban would lead to ~8.5% decrease in annual spending in West Yellowstone
- The annual growth rate in tourist spending in WY is ~9%
- Estimated decline in visitor spending is less than the annual growth rate in WY.
- During Federal shutdown of 95-96 West Entrance visits dropped by 13.4% over 94-95 season.
- West Yellowstone resort tax collections increased by 9.6% during this same period

Literature Summary: Endangered Species Meta-analysis

- Meta-analysis equation: do studies as a whole show a statistically significant effect?
  - To the size of the change
  - To the payment frequency
  - To the question format
  - For visitors vs. households
  - For species groups (e.g. marine)

Source: Loomis and White 1996

Summary of Economic Values of Rare and Threatened and Endangered Species (1993$) Annual WTP studies

Species	Low value	High value	Average
N. Spotted owl	$44	$95	$70
Pac. Salmon/Steelhead	$31	$88	$63
Grizzly bears			$46
Whooping cranes			$35
Red-cockaded Woodpecker	$10	$15	$13
Sea otter			$29
Gray whales	$17	$33	$26
Bald eagles	$15	$33	$24
Bighorn sheep	$12	$30	$21
Sea turtle			$13
Atlantic salmon	$7	$8	$8
Squawfish			$8
Striped shiner			$6

Summary of Economic Values of Rare and Threatened and Endangered Species (1993$) Studies Reporting Lump-sum WTP

Species	Low value	High value	Average
Bald eagles	$178	$254	$216
Humpback whales			$173
Monk seal			$120
Gray wolf	$16	$118	$67
Arctic grayling/Cutthroat Trout	$13	$17	$15

Meta-analysis Results: Regression for WTP of ESA Species (sample-38, Adj R sq. 0.682)

Variable (t-statistic)	Linear model
Changesize	0.59 (5.06)
Payfrequency	45.51 (2.89)
CVform	14.33 (1.12)
Visitor	24.03 (1.71)
Fish	24.26 (1.31)
Marine	49.87 (2.58)
Bird	33.41 (1.85)